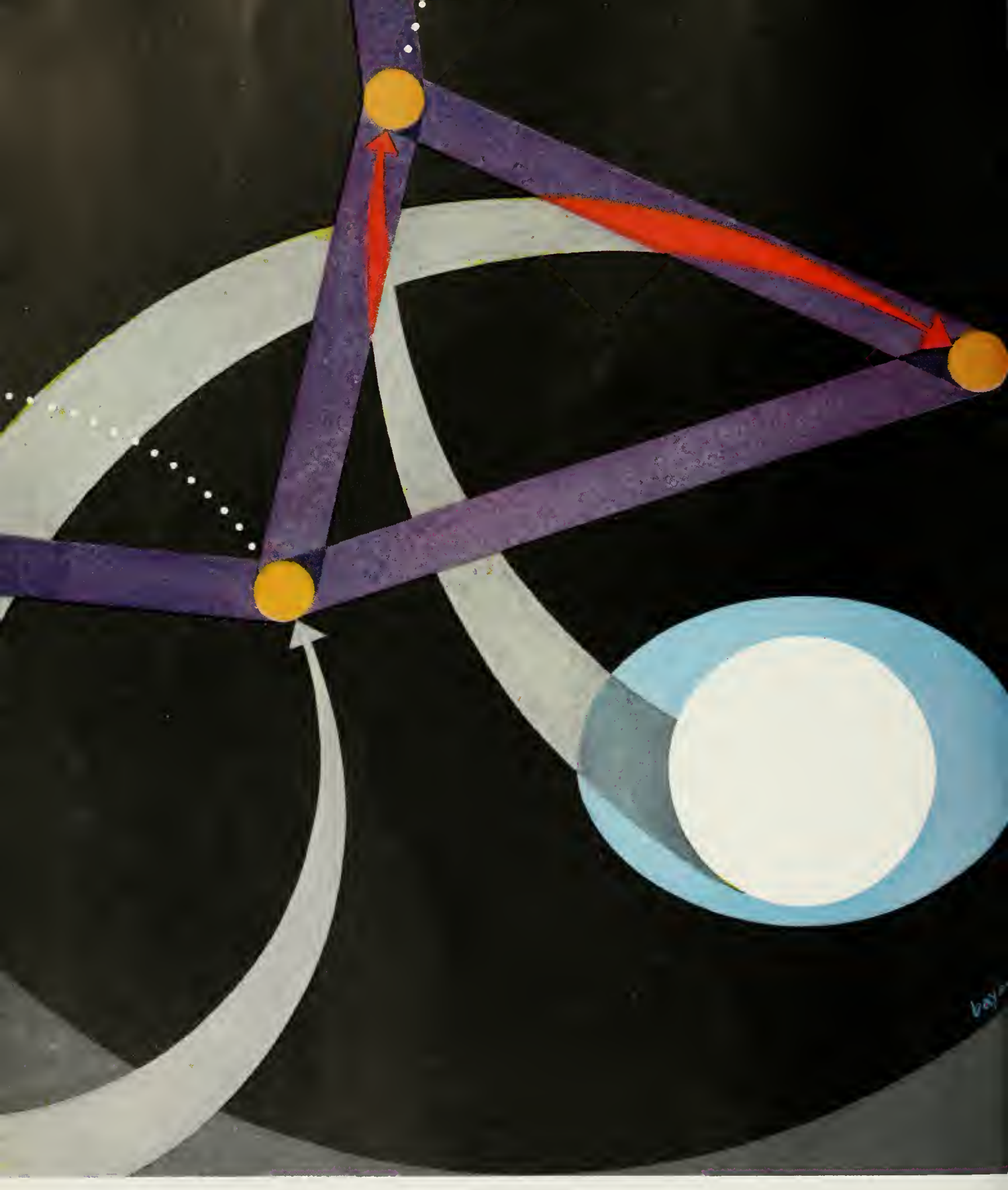
ILLINOIS

No. 7 – 25c

TECHNOGRAPH



Westinghouse developments will send words and pictures millions of miles from spacecraft to spacecraft

A beam of modulated light extending into the ultraviolet will some day carry messages, even TV pictures, from one spacecraft to another, or from a spacecraft to a satellite, across the vastness of outer space. This beam will travel 50 million miles with a single watt of transmitted power. It will be so concentrated that interception or jamming will be virtually impossible. A transmitter about the size of a hatbox will send messages farther than a conventional radio transmitter as big as a steamer trunk. How soon will it be ready? Westinghouse has already demonstrated its feasibility in the laboratory.

Learn more about the diverse and challenging space age research and development projects at Westinghouse, an equal opportunity employer. Talk with the Westinghouse representative when he visits your campus, or write L. H. Noggle, Westinghouse Educational Department, Ardmore Boulevard and Brinton Road, Pittsburgh 21, Pa. You can be sure . . . if it's Westinghouse.

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THE ILLINOIS TECHNOGRAPH

Volume 78; Number 7 April, 1963

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The Cover: by Bill Smoll

Life On Other Planets

Holding the line . . . for a richer harvest

Boll weevil, codling moth, leaf rollers, thrips and beetles . . . these are only a few of the thousands of insects that chew up millions of dollars worth of farm crops each year. Fortunately, however, they are no match for a new Union Carbide product called SEVIN insecticide. In the United States and many other countries, the use of SEVIN has already saved such staple crops as cotton, corn, fruits and vegetables from destruction by ravaging insects. ▶ You can now get SEVIN insecticide for your own garden as part of the complete line of handy EVEREADY garden products that help you grow healthy vegetables and flowers. SEVIN comes from years of research in Union Carbide laboratories and at an experimental farm in North Carolina where scientists prove out their latest agricultural chemicals. ▶ This is only one area in which chemicals from Union Carbide help improve everyday living. The people of Union Carbide are constantly at work searching for better products that will meet the needs of the future.

A HAND IN THINGS TO COME

UNION CARBIDE

LOOK *for these famous Union Carbide products*—SEVIN *Insecticide*, EVEREADY *Garden Chemicals, "6-12" Insect Repellent*, LINDE *Synthetic Emeralds and Stars*, PRESTONE *Car Care Products. Union Carbide Corporation, 270 Park Avenue, New York 17, N.Y. In Canada, Union Carbide Canada Limited, Toronto.*

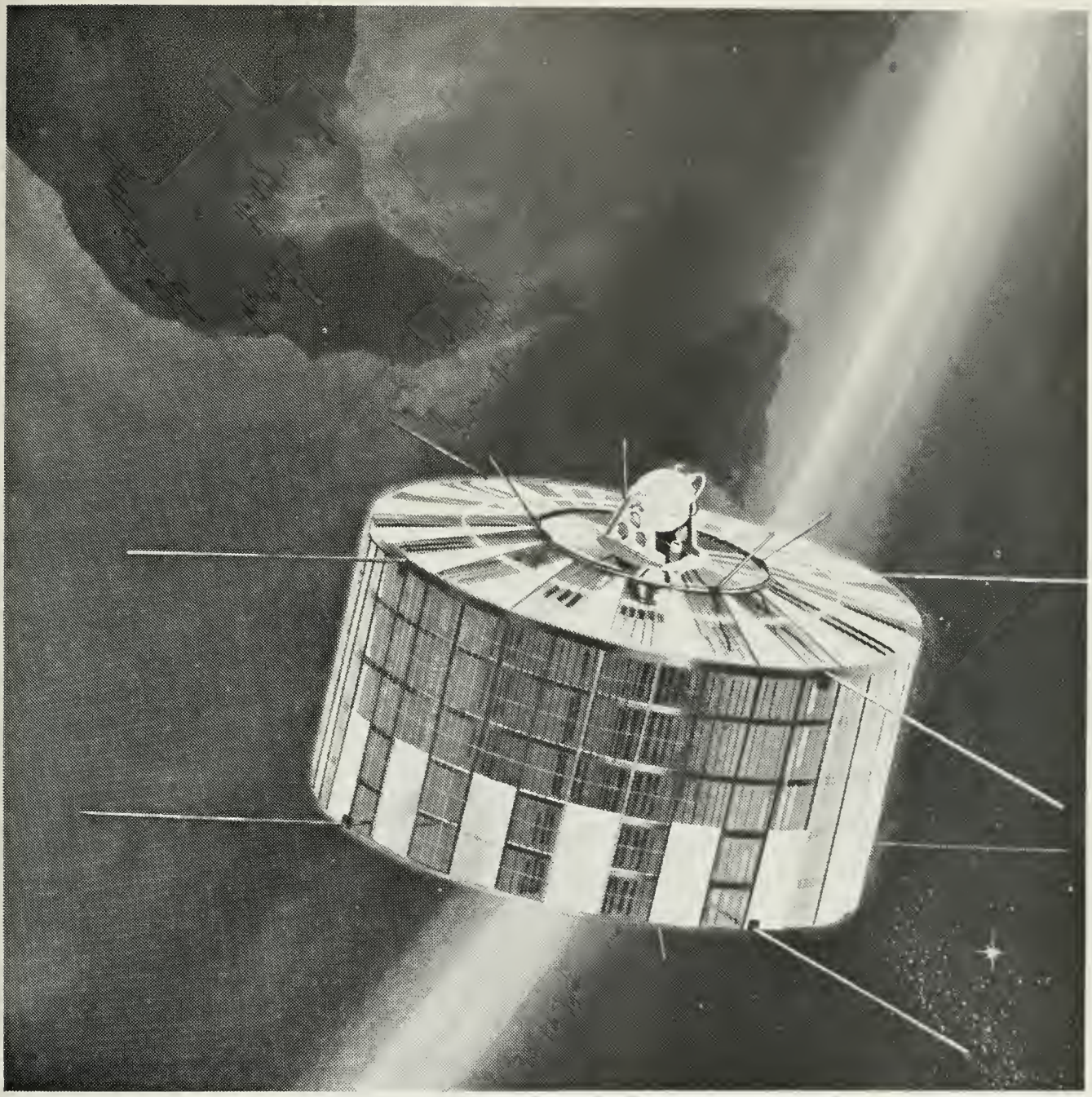

Illustration Courtesy The Martin Company

Atomic power for outer space

Monsanto . . . a world leader in chemicals, plastics and petroleum products . . . has also taken a giant step into the atomic space age. Now broadcasting signals from space is a *Transit* satellite transmitter, powered by an "atomic generator." This long-lived power source is fueled with plutonium 238 processed and encapsulated at Mound Laboratory, which Monsanto Research Corporation, a wholly owned subsidiary of Monsanto, operates for the Atomic Energy Commission.

This achievement is important to *you* because it suggests the kind of future the Monsanto family offers the young engineer of exceptional promise. You'll be joining a company that's ready and able to move vigorously into new fields. And that means plenty of growing room for *you* . . . ever-expanding opportunity as your professional interests broaden.

See your Placement Director to arrange an interview when we visit your campus soon. Or write today for our new brochure, "You, Your Career and Monsanto," to Professional Employment Manager, Department EM-5, Monsanto Chemical Company, St. Louis 66, Missouri.

Monsanto®

ALL QUALIFIED APPLICANTS WILL RECEIVE CONSIDERATION WITHOUT REGARD TO RACE, CREED, COLOR OR NATIONAL ORIGIN

Less and Less about More and More

Definition of an Engineer: One who learns more and more about less and less until he knows everything about nothing.

Herbert Hoover would no doubt disagree with this definition (See page 21). TECHNOGRAPH certainly disagrees, and to disprove this definition here is less and less about more and more until you know nothing about everything.

ISPE-MSPE Convention

"Meet me in St. Louis" is the theme of this year's combined Illinois-Missouri Professional Engineers 1963 Joint Convention, May 3-4, 1963, at the Sheraton Jefferson Hotel, St. Louis, Missouri. Student ISPE members should write E. W. Markwardt, P.O. Box 81, Belleville, Illinois, for information and pre-registration forms. Faculty members are encouraging all students to attend if possible.

FREE—100 Page Design Manual

TECHNOGRAPH has made special arrangements with the American Sprocket Chain Manufacturers Association for our readers to receive a free copy of the "Design Manual of Roller and Silent Chain Drives." This 100 page, hard-cover, 8½x11 inch book is the only authoritative source of this design data. . . . A "must" for M.E.'s and Ag students.

Included in its contents are: Horsepower Chart and Rating Tables; Application of Chain Drive Design to a Specific Problem; Silent Chain Horsepower Rating Tables per Inch of Chain Width; Sprocket Design; Standard Keys and Keyways.

To get your free copy, just write a brief note to TECH, 215 C.E.H., or telephone 333-1568 (2-5 Mon. or Wed.), TECH will order the book, and it can be picked up in about ten days.

Technical Writing Books and Articles

A "must" for would-be technical writers is a new book TECHNICAL WRITING by Richard Smith. This $1.25, 175 page book is one of the "College Outline Series." It is available at the campus book stores, or it can be obtained from the publisher—Barnes and Noble, Inc. The book covers the preparation of manuals, reports, proposals, and articles for both industry and government. The text covers the functions of the technical writer; technical writing style; preliminary steps; the technical manual, report, proposal, and article; the duties of a technical editor; writing the technical film; technical advertising and publicity; the mechanics of the trade; and the future of technical writing. A self-testing section is included to be used before and after studying the text.

Potential technical writers will also be interested in an article in the May issue of *Electronics World*. "Are You a Potential Electronics Technical Writer" by Cyrus Clickstem discusses the background for technical writing; military, commercial, and general technical writing and the advantages and disadvantages of each; military writer grades; and technical writing jobs.

Illinois Fifth in Total Number of Engineers

Fifty two thousand (52,000) engineers (an increase of 35% since 1950) are employed in the state of Illinois to place it fifth in the nation. California is first with 124,700 (147% increase over 1950); New York is second with 86,700 (43% increase); Ohio and Pennsylvania are next in line with 54,900 (47% increase) and 53,300 (37% increase) engineers employed. The total rise in engineering employment since 1950 represents an increase four times the growth of total employment and nine timees the growth in male employment.

1957 Engineering Graduate Salaries

Engineering graduates of the University of Illinois' class of 1957 have increased their salaries 62% in slightly more than five years. The average starting salary was $477 a month in 1957, and after five years they now earn an average of $771. Aeronautical engineers with B.S. degrees began highest in 1957 at $505 a month. Today these men average $812 but are topped by the electrical engineers who started at $487 and now get $857, and by engineering physicists, who started at $464 and now average $950.

Science and Engineering Weekend May 10-11

Don't forget to mark these dates on your calendar. For the first time Science and Engineering weekend will be presented by the joint efforts of the following groups: Engineering Open House; Illinois Junior Academy of Science; The 11th Annual Junior Engineering Technical Society Exposition; and the Veterinary Medicine Open House. For a full program of events see the March issue of TECHNOGRAPH. Extra copies can be obtained by writing TECH and enclosing 25 cents per copy.

Gary Daymon

MAN-RATED SPACECRAFT

...A STIMULATING AREA FOR CREATIVE ENGINEERS

Exploration of the universe by spacecraft capable of safely transporting men takes vast down-to-earth preparation. That's why Douglas is now building the nation's most modern research and development facility on a 245 acre site in Huntington Beach, California. □ The Douglas Space Systems Center will include a space simulation chamber 39 feet in diameter, capable of housing a complete manned spacecraft. Supplementing this will be a complex of specialized research laboratories. Here, manned space systems will be proved in environments similar to those which will exist on orbital, lunar and interplanetary missions. □ Douglas understanding of space problems is a direct result of booster experience and manned vehicle experience with high performance military aircraft.

If you are seeking a stimulating career in the thick of the most vital programs of today and tomorrow, we invite you to contact us. Write to Mr. S. A. Amestoy, Douglas Aircraft Company, 3000 Ocean Park Blvd., Santa Monica, California, Box 600-M. Douglas is an equal opportunity employer.

DOUGLAS

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An equal opportunity employer

Life support for 14 days in space

The NASA-McDonnell Project Gemini is the major link between Project Mercury and Project Apollo (this nation's first flight to the moon). It will give our space effort vital information on prolonged spaceflight effects and will also be used to test space rendezvous techniques.

Gemini's advanced environmental system will keep the spacecraft's two astronauts comfortable for two weeks of continuous orbital flight. Garrett-AiResearch builds the system that provides a breathable atmosphere, pressurization, temperature control, ventilation and atmosphere purification in the two-man spacecraft and in both astronauts' suits for the entire flight. AiResearch also supplies the supercritical cryogenic oxygen and hydrogen tankage system for the spacecraft's fuel cell power supply.

This is but one more example of Garrett's proved capability in the design and production of vital systems and their components for spacecraft, missile, aircraft, electronic, nuclear and industrial applications.

For further information about the many interesting project areas and career opportunities at The Garrett Corporation, write to Mr. C. D. Bradley in Los Angeles. Garrett is an equal opportunity employer.

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CO-OPERATIVE WORK-STUDY PROGRAMS IN ENGINEERING

by Dean DAVID R. OPPERMAN

There have been two co-operative work-study programs between industry and the College of Engineering at the University of Illinois since 1956 which have involved a limited number of students. In recent months there has been a renewed interest in co-op programs on the part of industry, and as a result the University of Illinois is expanding its program. One additional company has joined in the program and negotiations are under way with two other companies.

Co-operative work-study programs alternate periods of study in formal college courses with periods of work experience in industry. Co-op programs are not at all new and certain schools, such as the University of Cincinnati, emphasize co-op programs for the entire student body. Two other large midwestern schools with extensive co-op programs are Northwestern University in Evanston, Illinois, and Purdue University at West Lafayette, Indiana.

Approximately 25 undergraduate engineers at Illinois are presently on co-op programs with industry. Because of the expansion of the program it appears that there will be an opportunity for double that number of students to be on co-op programs during the 1963-64 school year. Students who are interested in beginning a program of work and study with industry should start making plans immediately since selections for co-op programs are generally made several months ahead of the time that the student enters his industrial work period.

There are opportunities for high school students to enter a co-op program as well as for students who are currently enrolled in engineering. A typical work-study program will have the student complete his freshman year at college before he enters his period of practical work experience in industry. Following his first work experience he will return to school and then alternate periods of work and study until his senior year of college studies. Generally the senior year is spent at the university and the student will receive his bachelor of science degree at the conclusion of that year of study. Two typical plans for alternating work and study are shown in the accompanying illustration.

Most co-op programs are flexible within certain limits. Commitments are not binding and can be adjusted to fit the needs of the students or of industry. However, it is hoped that students who enter a co-op program will follow their original curriculum and schedule of studies and work experience as nearly as possible. Since the industrial firms try to keep approximately equal numbers of students in school and at the plant simultaneously, it is apparent that wholesale shifts of schedules could easily disrupt the ability of the company to schedule a meaningful work experience. The work experience ordinarily involves a system of rotation between the various facets of the company's operations so that both the company and the student can become familiar with each other.

Students often wonder whether or not it is wise to enter a cooperative work-study program with an industrial firm. There are many advantages to such an arrangement as well as certain disadvantages. The final decision will have to be made by the individual student based upon his own personal circumstances.

One of the more obvious advantages to the student is that he gains practical work experience during the time that he is studying engineering in college. The theoretical material that the student learns in the classroom may be applied during his industrial experience. In addition, the student receives valuable counseling and challenging job assignments that will help him plan his future career in engineering.

Salaries paid to students during their work periods are substantial. The McDonald Aircraft Corporation estimates that students on their co-op program may earn as much as $8,000 during the five years that they are on the program. The National Aeronautics and Space Administration co-op program gives their students progressive salary increases up to a maximum of $380 per month during the final work experience period. The money that the student earns during these periods of time can be used to help finance his education. The co-op program guarantees certain periods of employment for the student during his education thereby releasing him from the burden of finding a job in industry each summer or remaining unemployed.

The educational experience that the student receives becomes more meaningful through his association with practicing engineers in industry during his college years. The student gains a feeling for his profession by witnessing it in action. To a certain degree, the student gets started on his professional career even before he receives his baccalaureate degree. These kinds of experiences can enrich college studies so that the graduate of a co-op program is in a position to be more useful to the company for which he goes to work.

The advantages enumerated above are offset by a number of disadvantages. Perhaps the most significant disadvantage is that the co-op student is limited in his extra curricula activities which form an important part of the learning experience during the college years. It would be most difficult for a co-op stu-

dent to participate in advanced ROTC training or student tours abroad since he would not have summers available for these activities. In addition, other activities such as glee club, university theatre, varsity athletics, student societies, etc., lose their continuity for the student if he is constantly alternating his period of attendance at the university.

The co-op student loses time toward graduation which can be of considerable economic importance. The average starting salary of a graduate engineer is now approximately $600 per month. The salary earned during the employment periods in a co-op program should be weighed against the salary lost by delaying graduation.

Students often ask why companies desire to establish co-op programs with the universities. Probably the most significant reason for establishing a co-op program is that it gives the company an opportunity to look over a future employee.

The program establishes a certain relationship between the student and the company which many times will result in the student seeking employment with the company after graduation even though no such binding commitment is demanded of a co-op student. Some companies estimate that they spend at least $2,000 to recruit each engineer that they hire. An effective co-op program can save an industrial firm many thousands of dollars over a period of time if the company is not forced to recruit on the open market.

Most industrial firms recognize a certain obligation to assist education. This assistance may take the form of scholarships, financial grants to institutions, research grants, or, it may take the form of direct financial aid to students through a cooperative work-study program. There are certain numbers of students who would not be able to attend college if they were not guaranteed employment during their college years. A cooperative work-study program assists students to finance their education by interspersing it with periods of employment and practical work experience in industry.

At present, three employers have active cooperative work-study programs with the College of Engineering at the University of Illinois. They are the Rock Island Arsenal at Rock Island, Illinois, the McDonald Aircraft Corporation at St. Louis, Missouri, and the National Aeronautics and Space Administration Test Facility at Edwards Air Force Base, Edwards, California. Since each of these groups is located in an area where students can continue their education through night school classes, extension courses, or by correspondence, they encourage students to continue their academic work on a part time basis during their employment periods. The courses taken, if properly chosen, can be used toward the bachelor of science degree at the University of Illinois and can help the student lighten his academic schedule.

There are no special qualifications for entering a cooperative work-study program except that most companies prefer that the student be unmarried and in the upper half of his college class. The companies usually prefer to select their high school participants from the top 10 or 15% of the high school graduating class. The students are never asked to sign any binding commitments to remain on the co-op program for a specified period of time nor are they in any way obligated to go to work for the company after graduation. Women are equally as welcome as men to participate in a co-op work-study program.

Students wishing to secure additional information concerning the cooperative work-study programs at the University of Illinois may write to any of the following people:

Mr. G. H. Nickell
U. S. Army
Rock Island Arsenal
Rock Island, Illinois

Mr. Scott King
Training Department
McDonald Aircraft Corporation
Box 516
St. Louis 66, Missouri

Mr. Gerard W. Herbert
Training Officer
NASA Flight Research Center
Box 273
Edwards, California

Additional information and application blanks concerning these programs may be obtained from the Office of the Associate Dean, 103 Civil Engineering Hall.

A TYPICAL WORK-STUDY PROGRAM

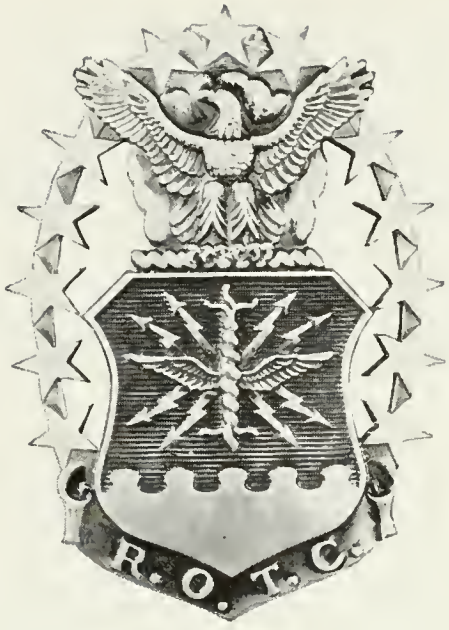
PLAN A

	First Year			Second Year			Third Year			Fourth Year			Fifth Year		
	Fall	Sp.	Sum.	Fall	Sp.	Sum.	Fall	Sp.	Sum.	Fall	Sp.	Sum.	Fall	Sp.	Sum.
Semesters on Campus	1	2	2½		3½		4½			5½			6½	7½	8
Work and Study Periods	S	S	S	W	S	W	S	W	W	S	W	W	S	S	S

PLAN B

	First Year			Second Year			Third Year			Fourth Year			Fifth Year		
	Fall	Sp.	Sum.	Fall	Sp.	Sum.	Fall	Sp.	Sum.	Fall	Sp.	Sum.	Fall	Sp.	Sum.
Semesters on Campus	1	2		3	4	4½		5½			6½			7½	8
Work and Study Periods	S	S	W	S	S	S	W	S	W	W	S	W	W	S	S

S--Study Period on Campus W--Work Period in Industry



Missed A.F.R.O.T.C.?

Go A.F.O.T.S.!

These letters stand for Air Force Officer Training School—the gateway to an Air Force career for ambitious college men who didn't have the chance to enroll in AFROTC.

OTS is a tough course. But it's a great opportunity—one that may not always be available. If you're within 210 days of graduation, we welcome your application now. We can't guarantee that we'll be able to in a year.

As an Air Force officer, you'll be a leader on the Aerospace Team. You'll be serving your country while you get a flying headstart or an exciting career.

The U.S. Air Force is at the forefront of every vital new technological breakthrough of the Aerospace Age. It sponsors one of the world's most advanced research and development programs—and you can be part of it.

OTS is open to both men and women. For information, see your local recruiter.

U.S. Air Force

. . . to Find Fresh Proof of Life in Space

Few scientists expect that in the near future we shall make contact with intelligent life outside the earth, whether Martians or civilizations light years distant beyond the solar system. What is being sought at the moment is simply chemical or biological evidence—beyond what we already may have—that life exists or has existed outside the earth. Discovery of such evidence could come with startling speed, for the National Aeronautics and Space Administration (NASA) plans to make space probes of Mars very soon. Perhaps, before long, "puppet laboratories" can radio back their findings. It may be possible to retrieve samples of matter from Mars or elsewhere before the first manned flight. Thus it becomes urgent to decide how to identify extraterrestial life—either to settle upon the best existing methods or develop new ones.

Several years ago, after studying hydrocarbons in crude oil and soils and livings things, Dr. Warren G. Meischein, chief investigator in the NASA project, proposed that certain alkanes (complex, saturated hydrocarbons appearing in all these materials) are products of life. At that time he suggested using alkanes to investigate the existence of very ancient life on earth.

Instead, however, in 1961 alkanes were employed to discover the first scientific indication that life exists or has existed in space. It was proven that certain molecules within the core of the Orguiel meteorite resembled molecules made by living things on earth, a strong indication that hydrocarbons within the meteorite were also products of life. Later that year, microfossils of types unknown on earth were found within the same meteorite. Most resembled in general appearance, but not in structural detail, certain microfossils gathered from sediments throughout the world. The contents of the meteorite are still being widely investigated and their significance argued.

Perhaps these investigations, even before other material from space can be analyzed, may establish that life exists there. In any case, meteorite studies are an important preparatory school for space. The methods and techniques developed while analyzing meteorites may be applied to investigations of Mars, other planets, and the moon. It may not be necessary to capture living organisms or even fossils in order to demonstrate that life has established itself on Mars. Molecules of biological origin, such as the alkanes, may be the best evidence of the prior existence of life anywhere. The fact that molecules are invisible to the naked eye and must be investigated by instruments even has certain advantages. Modern instruments can define the structure of complex molecules with greater precision than the most objective observer can describe what he sees.

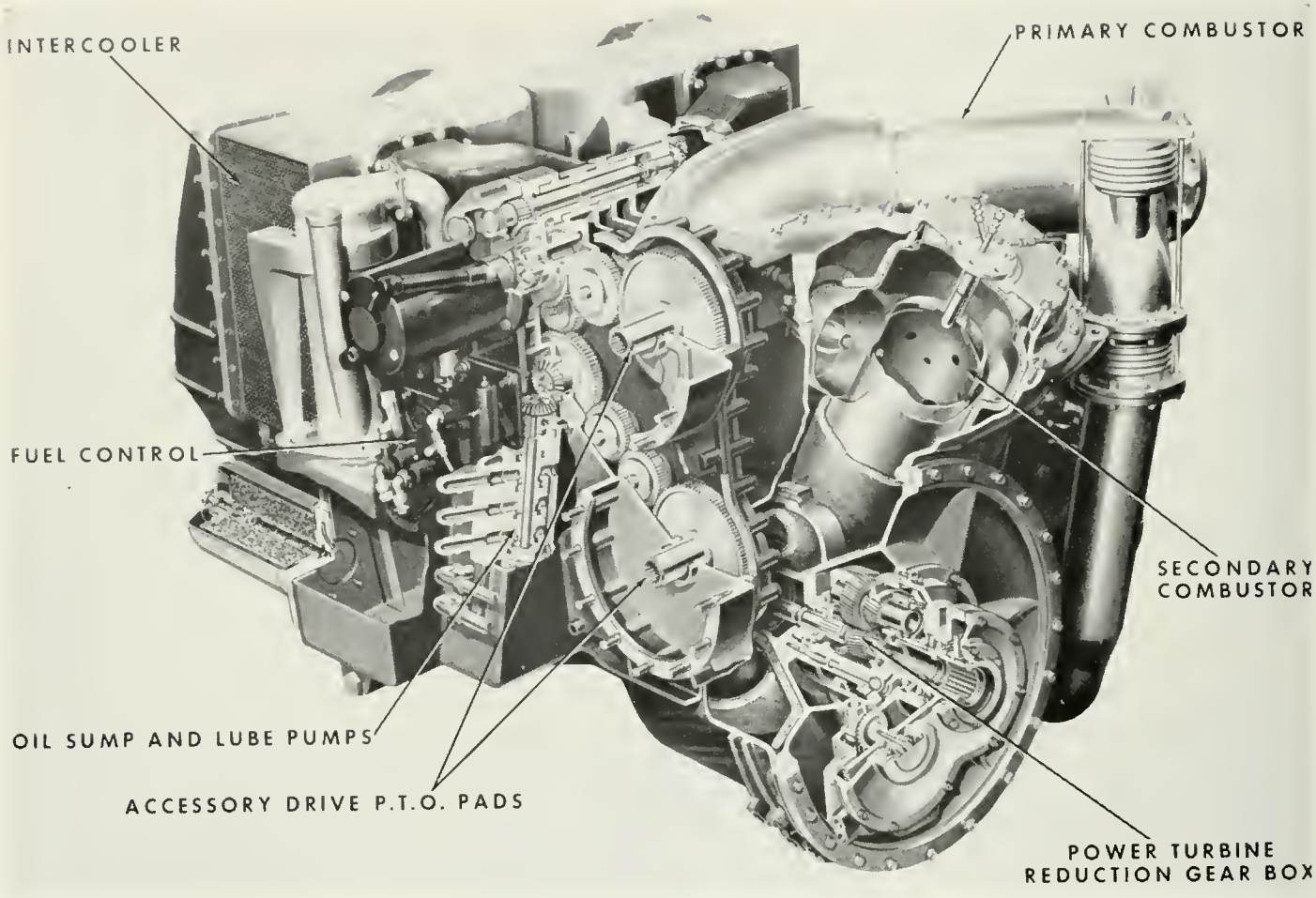
Molecules produced by living things are far more widely distributed than microfossils. They are also more stable and thus more reliable. Even the fossilized remains of organisms decay, passing, as Sheakespeare said, "through nature to eternity." But enroute, as the oil industry has learned, living things form compounds which may long outlast them. Sediments, the beds of ancient seas, once held primitive life that has long since vanished without a trace other than the enduring oil.

Dr. Meischein believes that the alkanes are probably the most widely distributed, the easiest to isolate, and the best preserved products of life, on this or other planets. Thus they may offer the best basis for comparison. The NASA project will make it possible to gather additional information about them.

More than one hundred leading American scientists, after an extensive study last year of the nation's space program, urged that finding life in space should become the first objective. The same group also observed that "chemical principles presumably hold good in all locales." In other words, whatever course life may have taken elsewhere, its beginning everywhere is probably much the same.

It is not inconceivable that the two greatest of mysteries—how life began and how widespread it may be—are to be solved not separately but together. The subject is of such magnitude and carries such philosophical and theological significance as to inspire an almost religious awe among scientists concerned. A discovery of life in outer space, supporting the meteorite investigations of 1961, would only confirm what many scientists now consider likely—that the whole universe is one vast laboratory of life. Even now we should conduct ourselves circumspectly, taking great care, for example, neither to contaminate Mars with earthly bacteria nor to bring back alien bacteria—remembering that the universe may not be our laboratory alone. ♦♦♦

Edited from the LAMP, published by Standard Oil Company of New Jersey, Spring, 1963.



THE 705

FUTURISTIC GAS TURBINE

The latest development in gas turbine engines was displayed several weeks ago by the Ford Motor Company. The 600-horse-power supercharged gas turbine was developed under a joint Army-Navy contract and is presently undergoing operational tests.

The unique feature of this new, comparatively light weight engine is supercharging, accomplished with two stages of compression. This allows the engine to use less air, maintain excellent fuel economy throughout its operating range, and employ smaller parts running at high speeds. This principle has always been considered by turbine engineers as difficult to accomplish and has never been attempted by any manufacturer in an engine under the 5,000-hp size. One part, the compressor, spins at 75,500 rpm, rotating the blade tips at supersonic speeds.

Problems such as this lead engineers to claim that without the aid of modern, advanced digital and analog computer techniques, they would not have been able to solve the complex aerodynamic and control problems encountered in this unique design.

Model 705, the name given the engine, is designed to meet the military's ever-increasing demands for a light, compact, low-fuel consumption engine, and particularly for one capable of consuming many types of fuels.

The Navy's requirements for an advanced gas turbine were based on the needs of future surface antisubmarine warfare craft, hydrofoils, hydroskimmers, minesweepers, and amphibious vehicles. The Army's needs are for a power plant for heavy vehicles, particularly tanks, auxiliary generator sets, and a variety of portable power plant applications.

These requirements mean the engine must be rugged enough to operate under field conditions, able to start at subzero temperatures, and must operate in a wide variety of adverse environmental conditions.

When it is equipped with snorkel in an Army tank for fording streams, the 705 is designed to run under 10 feet of water with no damage to its metal parts even though its combustion chamber operates at 1750 degrees Fahrenheit—above the melting points of such common metals as aluminum, magnesium, and zinc.

A number of unique features have been incorporated into the Ford engine design. Of significant interest to the military is the fact that the engine is virtually two engines in one. As a fuel-saving standby power plant, the unit is capable of delivering up to 45 hp from two accessory power take-offs with effectively only half of the engine running. By pushing a reset button on the control panel, the supercharging section of the engine is activated and the full 600 hp output of the engine is immediately available.

The turbocharged cycle consists of two stages of compression, using centrifugal compressors with air-to-air intercooling. From the high-pressure compressor, the air is manifolded to the recuperator, or heat exchanger matrix,

nd then to the primary combustor vhere fuel is added to the air and com-ustion takes place. From the primary ombustor, the hot gases pass through he high-pressure compressor turbine and nto a secondary, or reheat combustor, vhere fuel is again added before pass-ng the gas through the power turbine nd the low-pressure turbine which rives the first, or turbocharged, stage f compression. From the low-pressure urbine, the gas is diffused and slowed own in velocity before entering the re-uperator where it then exhausts into he atmosphere.

The engine consumes approximately ½ pounds of air per second, which in he process of compression through the wo compressors is raised in pressure o approximately 214 psi. The tempera-ure of the gas in each of the two com-ustors before passing through the tur-ines is 1750 degrees F. The tempera-ure of the gases exhausting from the ecuperator of the engine to atmosphere s approximately 660 degrees F.

The engine consists of five separate ssemblies all of which can be easily dis-ssembled from the main engine assem-ly for servicing or replacement. The ow-pressure or supercharging section of the engine comprises a single-stage centrifugal compressor which rotates at 36,600 rpm and is driven by a two-stage turbine. Discharge of the compressor is into a dual outlet plenum chamber on which are mounted the two intercooler matrices. The intercooler fan, which discharges into a plenum chamber mounted between the two intercooler units, is driven by the low-pressure-spool shaft through a spiral-bevel-gear drive train.

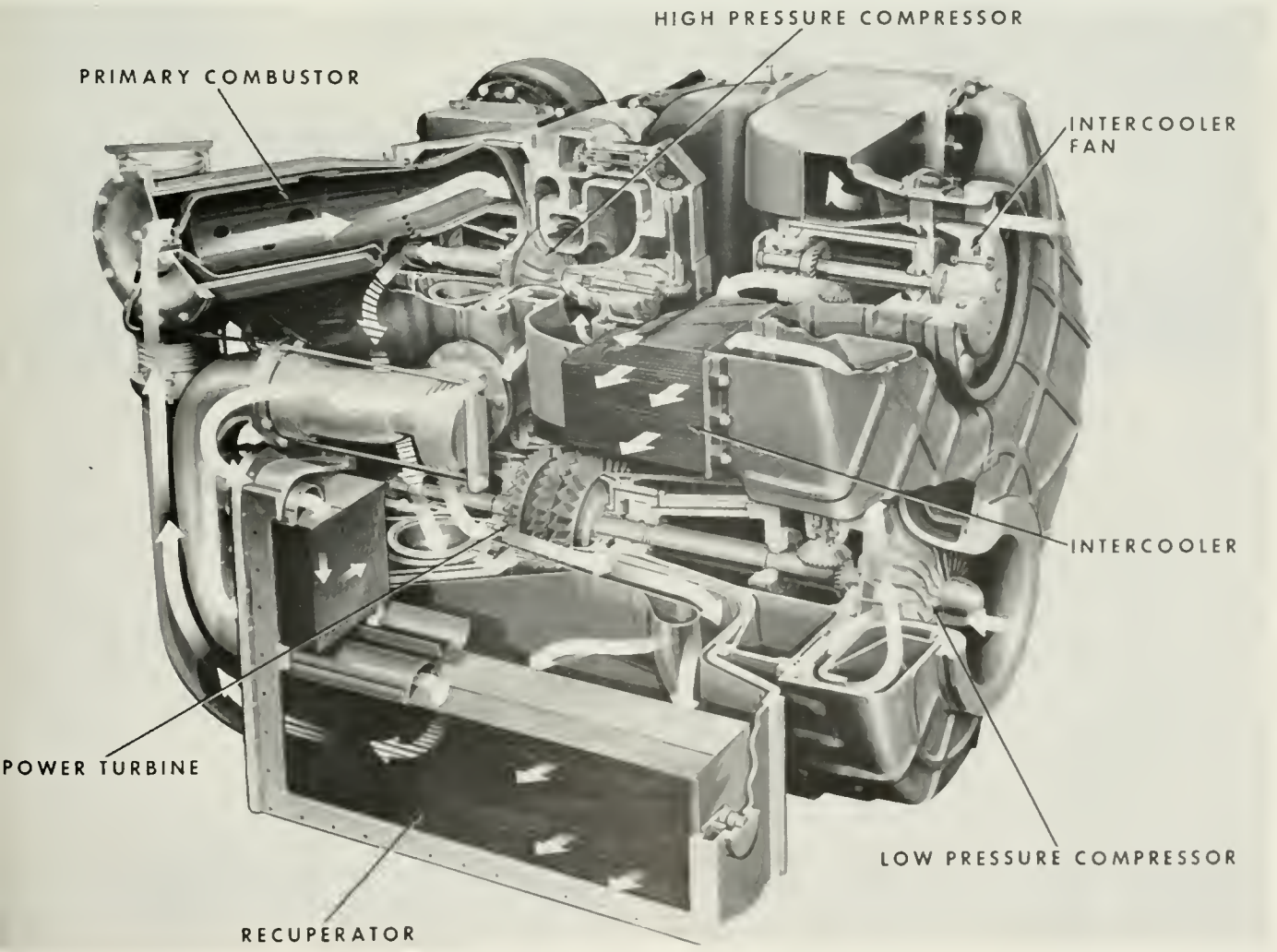
The second assembly is the high-pressure spool which receives air from the intercooler connecting duct. The spool comprises an overhung back-to-back centrifugal compressor radial inflow turbine, the centrifugal compressor discharging from a single scroll outlet connection to the recuperator matrix. Rated speed of the compressor is 75,500 rpm. The assembly is bolted to the rear main casing casting which is the backbone of the engine on which the primary combustion chamber is mounted. The primary combustor receives air from the recuperator and discharges into the radial inflow turbine driving the compressor, which exhausts into a diffuser duct and into the reheat burner.

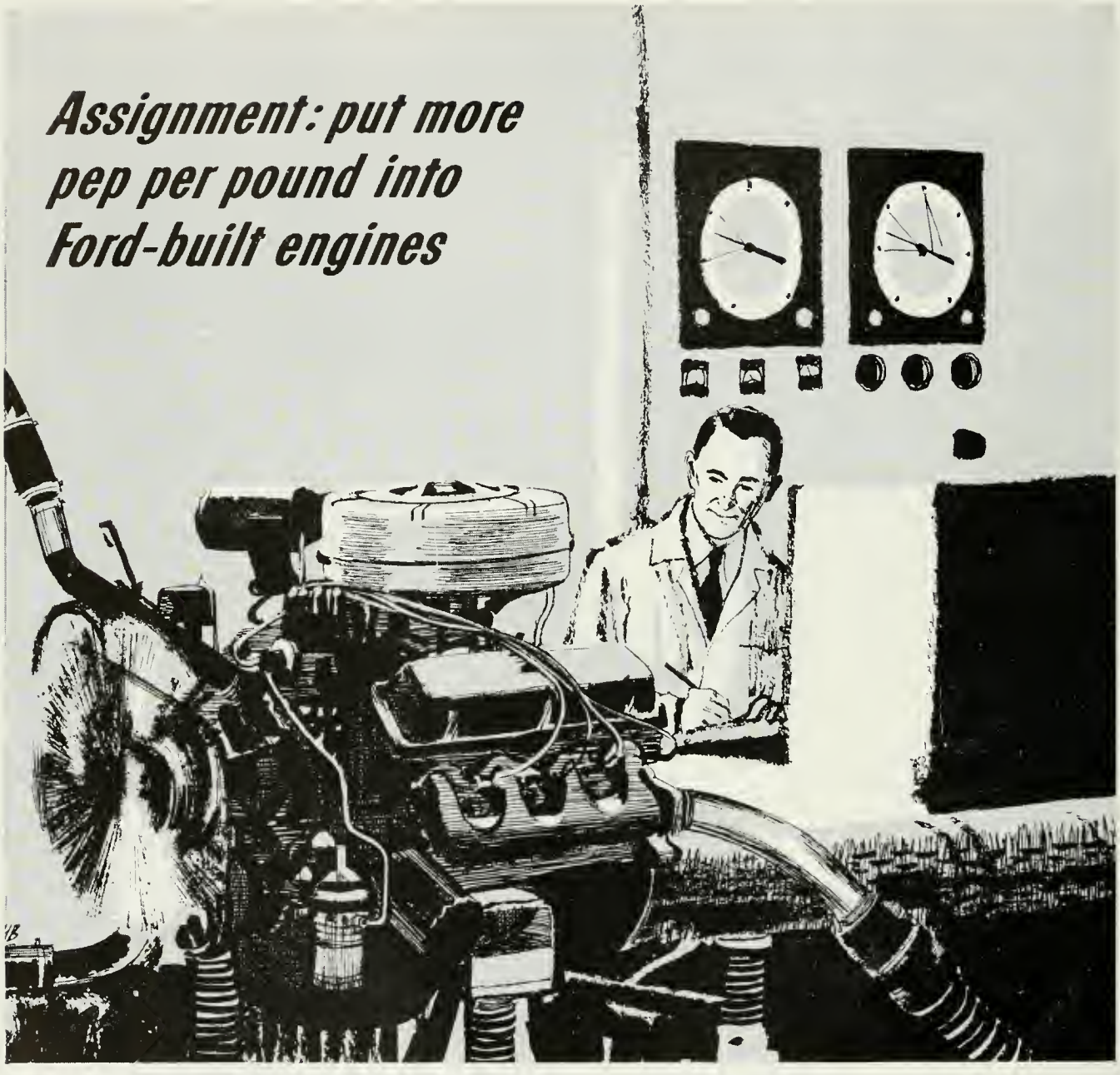
The third assembly of the engine consists of the power turbine and reduction gear box. The power turbine rotates at 30,600 rpm, the speed being reduced by a planetary reduction gear to 6000 rpm at the output shaft. The power turbine assembly is a plug-in unit to the rear main casing casting, the power turbine scroll mating with the reheat combustor at assembly.

The fourth major assembly is the recuperator, which is mounted to the low-pressure-spool exhaust diffuser casing on the right-hand side of the engine. The unit consists of two matrices which can be individually disassembled with distribution headers connecting the high-pressure compressor and the primary combustor.

The fifth major assembly consists of the accessory gear box which is driven by a spiral bevel gear and shafting arrangement from the high-pressure compressor shaft. The gear box is mounted on the left side of the engine and has an integral oil sump, the main engine lube pumps, and the fuel control and starter. Provision is also made on this gear box for two accessory pads with a total rating of 45-horsepower output and a drive for an oil cooler fan or water pumps.

♦♦♦





Result: New family of lightweight powerplants . . . including a new V-8 that weighs 110 pounds less than the comparable V-8 it replaces

In our search to provide good performance with lighter powerplants, Ford Motor Company engineers and foundrymen have pioneered new techniques that now let us cast our engine blocks with such precision that much lighter engines are made possible.

New materials used to make cores and molds and new casting methods enable us to make engine parts with walls as thick as necessary—but no thicker. This eliminates weight of extra material which must be used to provide adequate strength with less precise casting methods.

Reducing engine weight through precision casting means more performance per pound—and since lighter engines mean overall car weight can be reduced, better fuel economy results.

Another assignment completed—another Ford First—and one more example of how Ford Motor Company continues to provide engineering leadership for the American Road.

Ford

MOTOR COMPANY
The American Road, Dearborn, Michigan

WHERE ENGINEERING LEADERSHIP BRINGS YOU BETTER-BUILT CARS

BEGINNING

by Kenneth J . Breeding

If the following essay seems difficult or obscure, it is meant to be, but it **does** have a thought pattern. A brief explanation is therefore supplied as an outline and guide to understanding. The ideas presented have as their basic roots relatively complex physical and philosophical concepts. Thus, any explanation would, by necessity, be overshadowed by thought. With this in mind, however, a hint as to the full meaning is given. Be sure to read the essay before reading the key.

ESSAY

I've done my part and now I can rest. Time fleets too rapidly to finish. I'm sorry, and yet someday some brilliant mind may win. If only I knew that last little factor, all would be well. War—disgusting, yet I could have solved that problem if only time and knowledge hadn't run out. To die is not so bad, but to not finish is quite depressing. Unfortunately one can't obtain all knowledge—how disappointing. Tomorrow I'll rise and be done with it and yet never finish.

What's this? I see colors: black and white, orange and blue, trees, sky—oh, well, only passing of time until this is over. I see it. I see it! The solution. No, not I, we—we see it. If only I or we could tell before it happens. I see clearly and now we know all—we see all and nothing is a mystery any more. I note a long slender green thing feeding itself—from light. And yet I know it, for *we* know everything. What is this? I don't know these things and yet I do. Knowledge is all and symmetry is everything and all is necessary.

And yet now the quanta are becoming less frequent and lower in energy. Sol dies—slowly, oh so very slowly. Below, the blue sphere turns brown, and brown shifts low. Entropy cannot be reversed.

Ah, yes, and now it is gone and void remains with mind and lines of symmetry. But around there is nothing, for I am not me but we, and all is necessary to change. To change what? Ah, it's clear: when Sol is worshipped, thermodynamics is little understood.

Change to home takes work. This problem must be solved. And yet we have all to do—to work. Group it, shape it, twist it. Twist it? But why, and yet it is clear why. Home is solid and their problems will be solved. To work *on* is necessary; to think *on* is not, for thought has knowledge and all knowledge is us—to work on. The twist yields the hurdles to overcome. Thus a test to try again. The problem is simple, for we now understand but must go on. For to solve the twist, all will be successful, and home is here and yet there, and murder is through—eventually. We'll repeat and do good rather than evil this time.

Now the levels are here, straight and symmetrical. Symmetry means all for success and yet the twist of lines defeats it. Problems to solve—successfully this time. Now to adjust them a little more to obtain the proper word patterns of us, us and symmetry—a little more and just a bit. Ah, now we have it, let us say, "Let there be light." ♦♦♦

KEY

The sketch opens with a man lying on his deathbed, thinking. His thoughts concern an engineering and military and social problem on which he had been working, that of war and its elimination. On this, he had failed as a result of lacking some small piece of information. The last sentence of the first paragraph shows that he knows he will die soon and yet live on.

The second paragraph begins with his death: note the change in colors and in objects. He doesn't realize this transition, however, for he thinks, "—oh, well, only passing of time until this is over." Then he finds the solution to his problem which, unfortunately, he cannot communicate to earth. Now follows a series of visions in which he cannot realize that his all-knowing mind still exists. Yet it does, for he "knows" both the blade of grass, slender and green, and the process of photosynthesis. He also recognizes that he is not any longer just an entity but all things physically and theologically (note the reference to I and We). The last sentence then draws the analogy between knowledge and symmetry.

The third paragraph occurs many trillions of years later. Our thinker observes that the stars are dying. This conclusion is hinted at through the first and second sentences. He realizes that the Earth, "the blue sphere," is dying also. Finally all is gone in the decaying, energy-disorganizing "flow" of entropy.

After the death of the sun and the earth and all of the galaxies, he and they, separately and combined, united, try to find out how to start over again. In the last sentence of the fourth paragraph he discovers what is needed to do this. (This sentence is well worth thinking about.)

The remaining two paragraphs simply tell how he, or others, can go about this creation. There is much more in those two paragraphs than is suggested here. The curious reader may resolve further meanings himself. ♦♦♦

TECHNOCUTIE . . . . . .

Miss Flo Gault

An Engineer's 'IDEAL' gal

Truth should always supersede modesty, and in the case of Miss Florence (Flo) Gault it is a pleasure. Flo is perhaps the most "ideal" gal TECH has met during its 75 years of publication . . . This, by definition, makes her an engineer's daughter!

Flo was chosen Miss 1961-62 Champaign AmVet, Miss Illinois AmVet, and a finalist in the Miss America AmVet Contest held in New York last summer. Her radiating personality can be described best by quoting the AmVet's personality scoring cards. . . . Out of 50 possible points Flo scored 49!

She hails from Chicago, and during her 21 busy years she has been a professional fashion model for Morris B. Sacks, Carson Perry Scott, Marshall Fields, and the Chicago Tribune. Upon graduation in LAS next February she expects to become a high school teacher.

On the U. of I. Campus Flo has been a finalist for Illio Beauty and semi-finalist for Dolphin Queen as well as Sigma Kappa's Ideal Girl for Greek Ball Queen. She is a former activity editor of the Daily Illini, and her many hobbies include sewing, piano, swimming and water skiing.

TECH's Crystal Ball has indicated that Flo is particularly partial to General Engineering instructors (or is it only one?) with a B.S. in Mechanical Engineering working on an Economics degree. . . . We strongly suggest all interested persons in these areas investigate immediately—with due caution of course!!

1964 WORLD'S FAIR

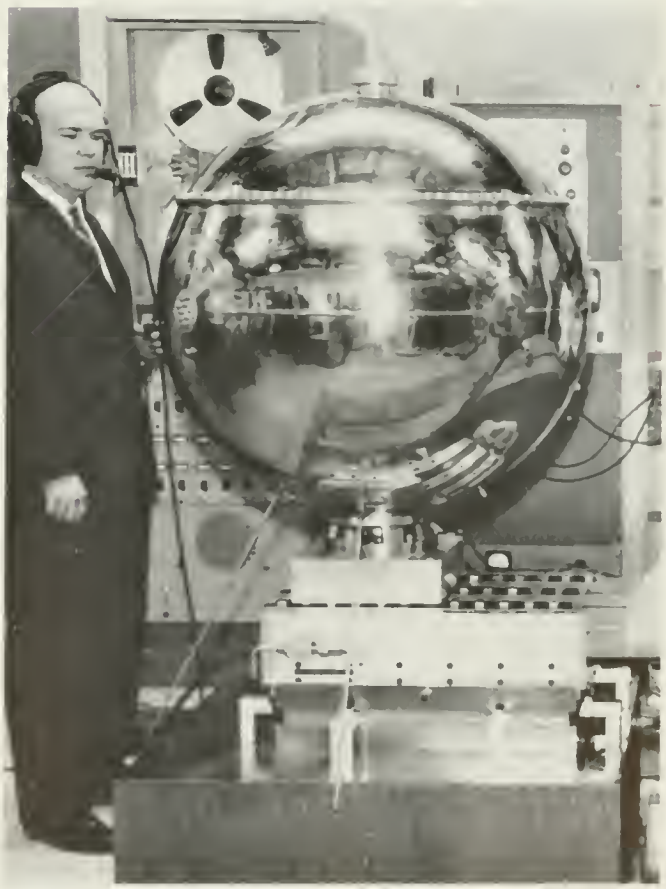
Seen by Artist John C. Wenrich in its permanent setting at Flushing Meadows, this is Unisphere, symbol of the 1964-1965 New York World's Fair to be fabricated, built and presented by United States Steel Corporation. Towering 12 stories above its pedestal, the Unisphere will feature land masses fabricated of rigidized stainless steel with a unique pattern, designed to heighten the effect of lights playing on it. The photo to the right shows the Unisphere under construction.

Atomic-Electric Generating Station

The dreams of nuclear power lighting a city are coming true. An atomic-electric generating station in Buchanan, New York, 35 miles from the center of New York City can presently furnish 275,000 of the six million kilowatts needed to serve the city. The steam that drives the turbine gets approximately two-thirds of its heat from the atomic reactor and one-third from oil fired superheaters. The core of the reactor uses thorium as fuel and will last approximately two years without refueling.

New Magnetic Shoes

This man is walking upside-down against the full pull of gravity to demonstrate a new permanent-magnet system developed at the Westinghouse Research Laboratories. Permanent magnets attached to the soles of his shoes clamp his feet securely to a steel beam. But unlike other permanent magnets they can, in effect, be turned on and off. The man can free his foot, take a step, then clamp it tight again. The new magnets need no constont source of electrical power as do conventional electromagnets, yet are just as easily controlled.



Stainless Steel Satellite

The latest in satellites is the stainless steel model shown here undergoing vibration tests that simulate the strain of launching. The shell is thinner than a match cover, nan magnetic, strong and nearly leakproof. For these reasons stainless steel is taking its place in the space age.

NEWS & VIEWS at the U. of I.

High Turbo-Charging of Diesel Engines

Recent research at the University of Illinois shows that a new level of diesel engine performance may be available in the near future.

Four-stroke gasoline engines that develop one or more brake horsepower per cubic inch of piston displacement have been produced for a number of years. These include engines for racing cars, larger aircraft engines of the reciprocating type, and, more recently, passenger and sports car engines. According to an investigation by Professor W. L. Hull of the University of Illinois Department of Mechanical and Industrial Engineering, it should be feasible to develop at least one horsepower per cubic inch of piston displacement in a production four-stroke diesel engine.

A single-cylinder, open combustion chamber diesel engine was equipped so that boosting the intake air pressure by means of an exhaust-driven turbosupercharger could be simulated. Compressed air was used at the intake, and the exhaust back pressure was controlled in proportion to that required to operate the turbine. The intake air temperature was regulated by using electric heaters. The intake air was boosted in excess of three atmospheres pressure and the effect of using after cooling to 200° F intake air temperature was simulated. These conditions were sufficient to produce one horsepower per cubic inch of piston displacement at 2,600 revolutions per minute speed. In addition to giving very high power output, high supercharging also reduced the fuel consumption per horsepower output by 24 per cent. This was because of the reduced percentage of friction and heat loss from the combustion chamber.

By using aftercooling of the intake air, excessive temperature due to compression can be avoided. This cooling can be accomplished by using either an air-to-air or an air-to-water heat exchanger, the latter being arranged to use cooling water coming from the engine radiator. By reducing this temperature, the specific weight of the intake air is increased further, so that more fuel can be burned, thereby increasing the horsepower still further. This also saves on the amount of work expended in supercharging, accounting partly for an improvement in fuel consumption.

High turbosupercharging should allow engine builders to produce more compact engines of lighter weight and lower cost per horsepower. The cost of operation of such engines should be extremely low because of the improved fuel consumption. In this test, brake mean effective pressures as high as 320 pounds per square inch were measured at 1,800 revolutions per minute, which gave maximum gas pressures in the engine cylinder of 2,800 pounds per square inch. This required making some of the engine parts considerably stronger to withstand the high stresses. The thermal efficiency of the engine ran as high as 39 per cent. A multicylinder engine of the same bore and stroke should be even better than this because multicylinder engines have a lower percentage of friction and heat loss than a single-cylinder engine.

Professor Hull presented a technical paper on this research, "High Output Diesel Engines," at the annual meeting of the Society of Automotive Engineers in Detroit on January 16. Copies of this paper are available from the SAE, 485 Lexington Avenue, New York City. *(Reprinted from Engineering Outlook)*

People and Places

Prof. R. C. Fuson, a distinguished chemist who has been at the University of Illinois since 1932, has been honored by a $10,000 gift from nearly 400 former students and associates to be used as he may suggest for the benefit of chemists and chemistry at the U. of I.

Dr. N. M. Newmark, Head of the University of Illinois Department of Civil Engineering, received the Theodore van Karman Medal of the American Society of Civil Engineers in October "in recognition of distinguished achievement in engineering mechanics and especially in structural dynamics."

Dr. R. B. Peck, Professor of Civil Engineering at the University of Illinois, was installed in October as a member of the Board of Direction of the American Society of Civil Engineers for a term of three years. He is now director for most of Illinois and part of eastern Iowa.

Charles H. Henry, graduate student in Physics at the University of Illinois, was awarded the Eastman Kodak Scientific Award of $1,000 in October. This prize is awarded "on the basis of outstanding contributions and progress either in graduate studies and research or in teaching."

Even When Its Not Pure, It Floats

Because the world's mineral resources are being used up so rapidly, today it is necessary to look for and try to obtain lower grade ores than would have been considered acceptable in the past. If mineral prices are to be kept reasonable, new methods of mineral beneficiation must be found or greater efficiency must be introduced into old methods. One of the widely used mineral processing methods in use today, flotation, is the subject of extensive research in the University of Illinois Mining, Metallurgy, and Petroleum Engineering Department by a group under the direction of Professor Norman Street.

Flotation is a process by which minerals are floated to the top of a liquid surface where they can be collected. The addition of the proper kind and amount of chemicals to the water for the mineral being separated will make air bubbles stick to mineral particles and float to the surface, leaving the useless impurities behind. Today many millions of tons of ores are processed in this manner.

Although it is well known that the right chemical in the right quantity will make a given mineral stick to the bubble and rise to the surface, much remains to be learned about the electrical potential differences between the liquid surface and the mineral surface. This is one of the facets of flotation being studied by Professor Street's group. When a captive air bubble is brought up to a mineral surface under a microscope, it is possible to see that a thin film of liquid persists for some time between the bubble and the mineral. To increase the efficiency of the flotation process, the time interval before this film ruptures must be made as short as possible. These rupture times are a function of the surface potential developed at the mineral-solution interface, and Professor Street's group is studying methods of changing surface potentials in order to speed film ruptures.

The group is also studying the "contact angle" between the liquid and the mineral, i.e., the angle a drop of the solution will adopt to the mineral surface in air, which affects the ability of a bubble to stick to the surface of the mineral. There appears to be a relationship between surface potential and rupture time. Although quite a lot of fundamental work has already been done, much remains to be learned about such interfacial phenomena. These studies of hydromechanics, electroviscosity, and electrokinetics take on more and more importance as our iron ore, petroleum reserves, and other mineral resources become harder to find, harder to obtain, and harder to refine. *(Reprinted from Engineering Outlook)*

UNMANIFEST PRIDE

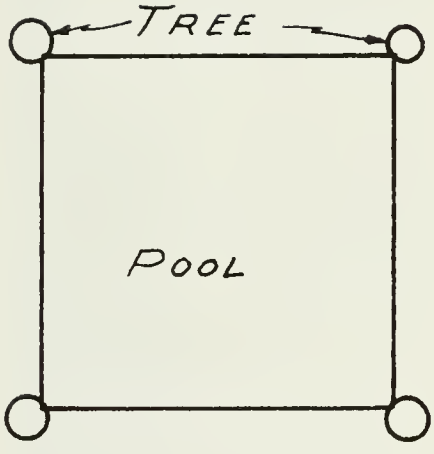
The great liability of the engineer compared to me of other professions is that his works are out in the open where all can see them. His acts, step by step, are in hard substance. He cannot bury his mistakes in the grave like the doctors. He cannot argue them into thin air or blame the judge like the lawyers. He cannot, like the architects, cover his failures with trees and vines. He cannot, like politicians, screen his shortcomings by blaming his opponents and hope that the people will forget. The engineer simply cannot deny that he did it. If his works do not work, he is damned. That is the phantasmagoria that haunts his nights and dogs his days. He comes from the job at the end of the day resolved to calculate it again. He wakes in the night in a cold sweat and puts something on paper that looks silly in the morning. All day he shivers at the thought of the bugs which will inevitably appear to jolt its smooth consummation.

On the other hand, unlike the doctor his is not a life among the weak. Unlike the soldier, destruction is not his purpose. Unlike the lawyer, quarrels are not his daily bread. To the engineer falls the job of clothing the bare bones of science with life, comfort, and hope. No doubt as year go by people forget which engineer did it, even if they ever knew. Or some politician puts his name on it. Or they credit it to some promoter who used other people's money with which to finance it. But the engineer himself looks back at the unending stream of goodness which flows from his successes with satisfactions that few professions may know. And the verdict of his fellow professionals is all the accolade he wants.

—From Herbert Hoover, *The Memoirs of Herbert Hoover: Years of Adventure*. Copyright 1951 by Herbert Hoover, The Macmillan Company.

BRAINBUSTERS

1.



A man has a square swimming pool with trees growing at each corner. He wants to double the area of the pool, but still keep it square. How can he do this without moving the trees? Of course, he doesn't want the trees in the pool.

3.

At the Green's family party, two tables sat down to play bridge. Those participating were Messrs, Green, Pink, Black, and White, and their respective wives.

White's partner was his daughter. Pink was playing against his mother. Black's partner was his sister. Mrs. Green was playing against her mother. Pink and his partner had the same mother. Green's partner was his mother-in-law.

No player's uncle or step-uncle was participating.

Who partnered whom, and how were the tables made up?

4.

I bowled a game with 8 strikes. No ball went into the gutter and I didn't four, but my score was less than 100. What happened in each frame?

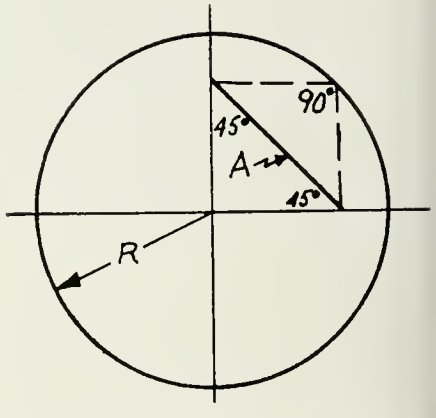
5.

What digits do the letters represent in this cryptic addition problem?

```
  T W O
  T H R E E
  S E V E N
-----------
  T W E L V E
```

It is obvious that the values for "O" and "N" may be interchanged.

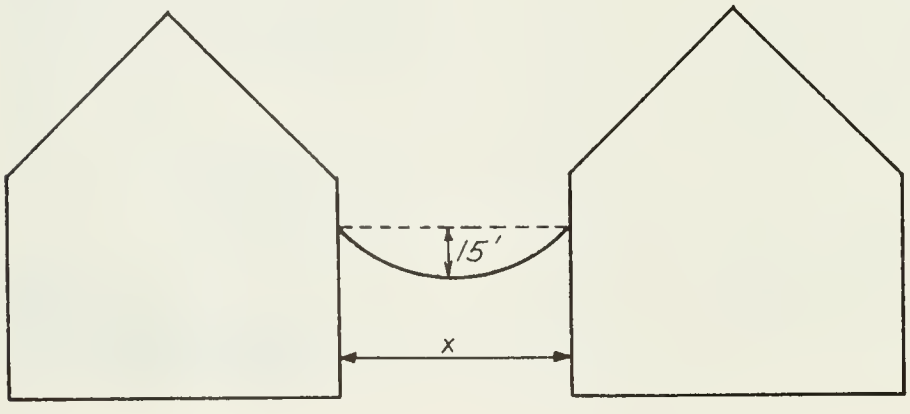
6.



How long is line A?

2.

The ends of a 30 foot rope are attached to the facing sides of two buildings. The sag in the rope is 15 feet. How far apart are the buildings?



7.

An important clue in a murder mystery was the dead man's "perfect" watch, which had stopped at the instant of the murder. However, the investigation officer had carelessly turned the hands in attempting to start the watch, and could not remember what time was indicated. He did recall that the hour and minute hand had been together and that the second hand had just passed the 49th second. At what time was the murder committed?

(See answers on page 24)

We're letting it out another notch... to keep up with area growth

ELECTRICITY POWERS PROGRESS

When economic activity grows at the rate it has in our service area — it needs the support of plenty of electric power. That's why we plan to add a 310 megawatt generating unit to our Oak Creek power plants by mid-1965. Addition of this seventh unit will increase the total capacity of the Oak Creek plants to 1,360 megawatts.

Building ever larger and more efficient generating units is one way that our company helps electricity power progress. Research in atomic power is another. And our engineers — assisted by computers — are "building" the power distribution systems of tomorrow.

Write us about engineering positions in all fields — plenty of opportunities to pioneer in a key industry!

WISCONSIN ELECTRIC POWER COMPANY SYSTEM

Wisconsin Electric Power Co.
MILWAUKEE, WIS.

Wisconsin Michigan Power Co.
APPLETON, WIS.

Wisconsin Natural Gas Co.
RACINE, WIS.

TECHNOQUIPS

With due respect to old Charlie Darwin, although man has learned through evolution to walk in an upright posture, his eyes still swing from limb to limb.

* * *

The two Madison Avenue types met on the suburban train platform.

"Hi, Charley," greeted the one, "how is your wife?"

"Compared to what?" responded the other dryly.

* * *

Then there's the one about the Texas oilman who went to see his dentist and, when asked which tooth was bothering him, replied, "Oh just drill anywhere, doc. I feel lucky today!"

* * *

A school inspector, to get an idea of the standard of teaching, entered a classroom while the lesson was in progress and decided to ask the children some questions.

Calling on one small boy he asked, "Who broke down the walls of Jericho?" The boy answered. "Not me, sir." The inspector turned to the teacher and asked, "Is this the usual standard in this class?" The teacher replied, "The boy is usually quite honest, so I believe him."

Leaving the room in disgust the inspector sought out the headmaster and explained what had transpired.

The headmaster said, "I've known both the teacher and boy concerned for several years and I'm sure that neither of them would do a thing like that."

By this time the inspector was furious and reported the incident to the director of education.

The director said, "I feel, you know, we are making a mountain out of a molehill in this case. I suggest we pay the bill and write the sum off."

* * *

Angry wife: "One of the ducks you were out shooting yesterday called and left her number."

Freshman Engineer: "It says here that if we study hard, don't drink, smoke, or run around with girls we'll live longer. Is that true?"

Professor: "We won't know for sure until somebody tries it."

* * *

The Kennedy family slogan: "Anything you can do my kin do better."

* * *

There are three ways of courting ruin—women, gambling and calling in technicians.

* * *

Motto hanging on office wall of a research department: "This problem, when solved, will be simple."

* * *

The regular noontime poker session of a group of Phoenix, Ariz., electronic engineers is neatly labeled with a sign reading: "Probability Seminar."

* * *

A man is incomplete until he's married—then he's really finished.

* * *

"All-Purpose Political Speech for Any Audience." Its opening paragraph:

"These are perilous times. We stand at the crossroads of decision, the frontier of destiny. Years ago this was not as true as it proved to be later on. Today there is an increase of 23 per cent in the national index alone. Mental illness accounts for an appalling three per cent. The rest goes for taxes."

* * *

The main advantage of being a nudist is that after you've been in for a swim you don't have to sit around in a wet bathing suit.

* * *

The human brain is wonderful. It starts working the moment you wake up in the morning and doesn't stop until you are called on to recite in class.

* * *

Math Prof: Now, if I subtract 25 from 37, what's the difference?

Fresh: Yeah! That's what I say. Who cares?

The Soviet commissar was examining a young Czech boy to determine whether he had been properly indoctrinated. When asked who his father was the boy replied "Joseph Stalin."

Beaming, the examiner then asked who his mother was. "The Great Soviet Union," came the prompt reply.

"Splendid," grinned the commissar, "you'll make a fine Red Army soldier. Now tell me," he continued, "what do you want to be when you grow up?"

"An orphan!" snapped the boy.

* * *

Social Worker: "Sir, would you be interested in contributing something to the old ladies home?"

"Yes, I'll send my mother-in-law over tomorrow."

* * *

The bandage-covered patient who lay in the hospital bed spoke dazedly to his visiting pal:

"What happened?"

"You absorbed too many last night, and then made a bet that you could fly out the window and around the block."

"Why," screamed the beat-up C.E., "didn't you stop me?"

"Stop you, hell, I had $25 on you."

* * *

The young wife approached a post office window and said. "I wish to complain about the service."

"What's the trouble, madam?" the clerk wanted to know.

"My husband is in Atlanta on business and the letter he sent me is postmarked Miami Beach."

* * *

Once upon a time, as the story goes, the fence between Heaven and Hell broke down. Satan appeared at his side of the broken section and called out to St. Peter: "Hey, St. Peter, since all the engineers are over on your side, how about sending a few to fix the fences?"

"Sorry," replied St. Peter, "my men are too busy to fix fences."

"Well then," said Satan, I'll have to sue you if you don't."

St. Peter: "Guess you win; you've all the lawyers on your side."

* * *

"You can't beat the system," moaned an U.I. student after looking at his semester grades. "I took a course in basket weaving for a snap elective and then two navahos enrolled and raised the curve so that I flunked."

BRAINBUSTER ANSWERS

Numbers 1, 2, and 6 are rather simple. If you can't figure them out ask your roommate.

Number 3. We don't even know the answer yet. Find out next month on the Tecchnoquips page.

5.

106	or	104
19722		19722
82524		82526
102352		102352

Number 4. A score of 99 is possible with strikes in all frames (including 11th and 12th) except the 3rd, 5th, 7th, and 9th. The no-strike frames are characterized by the horror of one down plus a miss. Slight variations are possible; for example the 2nd instead of 3rd frame might be substandard.

7. 4:21:49 1/11

Kodak beyond the snapshot...

Physical chemist. Currently working for the electronics industry. Salary by Kodak. Having a wonderful time.

Photography has penetrated everything, often unrecognized behind its disguises. With photography as a means of fabrication, the electronics business builds complex logic circuits smaller than the period at the end of this sentence. Technique depends on liquids hardened by light. Electronics engineers, knowing little about photopolymerization, turn to Kodak engineers. Kodak engineers turn to Kodak physical chemists for the photopolymers. *Ergo,* we pay physical chemists to work for the electronics industry. Typical instance of the delightfully unpredictable matchmaking that goes on in a thoroughly diversified outfit.

Some people, who will always prefer the scientist's way of life to any other, nevertheless derive a large bang from working often with engineers. Some people who class themselves engineers feel it can be a dull life without personal contacts with the sources of new knowledge. Kodak is a good place for these people to meet.

Maybe your interests and our interests match up somewhere. Write.

EASTMAN KODAK COMPANY • Business & Technical Personnel Department
ROCHESTER 4, N.Y. • We are an equal-opportunity employer.

An interview with General Electric's W. Scott Hill

One of a series...

Manager—Engineering Recruiting

How to Make the Most of Your First Five Years

MR. HILL has managerial responsibility for General Electric's college recruiting activities for engineers, scientists, PhD's and technicians for the engineering function of the Company. Long active in technical personnel development within General Electric, he also serves as vice president of the Engineers' Council for Professional Development, board member of the Engineering Manpower Commission, director of the Engineering Societies Personnel Service and as an officer or member of a variety of technical societies.

Q. Mr. Hill, I've heard that my first five years in industry may be the most critical of my career. Do you agree?
A. Definitely. It is during this stage that you'll be sharpening your career objectives, broadening your knowledge and experience, finding your place in professional practice and developing work and study habits that you may follow throughout your career. It's a period fraught with challenge and opportunity—and possible pitfalls.

Recognizing the importance of this period, the Engineers' Council for Professional Development has published an excellent kit of material for young engineers. It is titled "Your First 5 Years." I would strongly recommend you obtain a copy.*

Q. What can I do to make best use of these important years?
A. First of all, be sure that the company you join provides ample opportunity for professional development during this critical phase of your career.

Then, develop a planned, organized personal development program—tailored to your own strengths, weaknesses and aspirations—to make the most of these opportunities. This, of course, calls for a critical self appraisal, and periodic reappraisals. You will find an extremely useful guide for this purpose in the "First 5 Years" kit I just mentioned.

Q. How does General Electric encourage self development during this period?
A. In many ways. Because we recognize professional self-development as a never-ending process, we encourage technical employees to continue their education not only during their early years but throughout their careers.

We do this through a variety of programs and incentives. General Electric's Tuition Refund Program, for example, provides up to 100% reimbursement for tuition and fees incurred for graduate study. Another enables the selected graduate with proper qualifications to obtain a master's degree, tuition free, while earning up to 75% of his full-time salary. These programs are supplemented by a wide range of technical and nontechnical in-plant courses conducted at the graduate level by recognized Company experts.

Frequent personal appraisals and encouragement for participation in professional societies are still other ways in which G.E. assists professional employees to develop their full potential.

Q. What about training programs? Just how valuable are they to the young engineer?
A. Quite valuable, generally. But there are exceptions. Many seniors and graduate students, for example, already have clearly defined career goals and professional interests and demonstrated abilities in a specific field. In such cases, direct placement in a specific position may be the better alternative.

Training programs, on the other hand, provide the opportunity to gain valuable on-the-job experience in several fields while broadening your base of knowledge through related course study. This kind of training enables you to bring your career objectives into sharp focus and provides a solid foundation for your development, whether your interests tend toward specialization or management. This is particularly true in a highly diversified company like General Electric where young technical graduates are exposed to many facets of engineering and to a variety of product areas.

Q. What types of training programs does your company offer, Mr. Hill?
A. General Electric conducts a number of them. Those attracting the majority of technical graduates are the Engineering and Science, Technical Marketing and Manufacturing Training Programs. Each includes on-the-job experience on full-time rotating assignments supplemented by a formal study curriculum.

Q. You mentioned professional societies. Do you feel there is any advantage in joining early in your career?
A. I do indeed. In fact, I would recommend you join a student chapter on your campus now if you haven't already done so.

Professional societies offer the young engineer many opportunities to expand his fund of knowledge through association with leaders in his profession, to gain recognition in his field, and to make a real contribution to his profession. Because General Electric benefits directly, the Company often helps defray expenses incurred by professional employees engaged in the activities of these organizations.

Q. Is there anything I can do now to better prepare myself for the transition from college campus to industry?
A. There are many things, naturally, most of which you are already doing in the course of your education.

But there is one important area you may be overlooking. I would suggest you recognize now that your job—whatever it is—is going to be made easier by the ability to communicate . . . effectively. Learn to sell yourself and your ideas. Our own experience at General Electric—and industry-wide surveys as well—indicates that the lack of this ability can be one of the major shortcomings of young technical graduates.

**The kit "Your First 5 Years," published by the Engineers' Council for Professional Development, normally sells for $2.00. While our limited supply lasts, however, you may obtain a copy by simply writing General Electric Company, Section 699-04, Schenectady, New York.*

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